

Claims

1. Method of handling a wind turbine blade at least during storage, transport or mounting of the blade, said method comprising the steps of:
5 establishing at least one mounting hole penetrating the surface of the blade,

mounting one or more handling means including mounting means in said at least one hole, and
10 handling the wind turbine blade by at least said handling means on the wind turbine blade.
2. Method according to claim 1, wherein said at least one mounting hole is
15 established by a drilling process.
3. Method according to claim 1 or 2, wherein said at least one mounting hole is
marked with visual signs indicating the location of the hole e.g. visual lines or
20 circles on the surface of the blade.
4. Method according to any of claims 1 to 3, wherein said mounting includes
entering said mounting means through the blade.
5. Method according to any of claims 1 to 4, wherein said one or more handling
25 means are forced against the surface of the blade by said mounting means.
6. Method according to any of claims 1 to 5, wherein said handling means are
connected to handling rods, plates or walls.

7. Method according to any of claims 1 to 6, wherein the connection to said handling rods, plates or walls is established by use of bolts, thread bars, welding means or the like.
- 5 8. Method according to any of claims 1 to 7, wherein the blade is handled at least by the suspension points established by said handling means.
9. Method of manufacturing a wind turbine blade to be handled, said method comprising the steps of:
- 10 manufacturing at least a first and second shell of a wind turbine blade,
- reinforcing at least one hole area of the inner surface of at least one of said shells by applying further layers of material, and
- 15 establishing at least one hole penetrating the surface at said at least one hole area.
10. Method according to claim 9, wherein said at least one mounting hole is established by a drilling process.
- 20 11. Method according to claim 9 or 10, wherein said at least one mounting hole is marked with visual signs indicating the location of the hole e.g. visual lines or circles on the surface of the blade.
- 25 12. Handling system for handling a wind turbine blade (5) at least during storage, transport or mounting of the blade, said system comprising
- at least one mounting hole (22) penetrating the surface of the blade,

one or more handling means (9, 9a, 9b, 29, 29a, 29b) to be positioned on the surface of the wind turbine blade and mounting means (11-14) to be mounted in said at least one hole.

5 13. Handling system according to claim 12, where said handling means (9, 9a, 9b, 29, 29a, 29b) are connected to a handling structure such as handling rods (24), handling plates and/or handling walls (25) e.g. of a transport container.

10 14. Handling system according to claim 12 or 13, where said handling means (9, 9a, 9b, 29, 29a, 29b) comprise a surface substantially or partly corresponding in shape to the section of the wind turbine blade that it covers.

15 15. Handling system according to any of claims 12 to 14, where said handling means (9, 9a, 9b, 29, 29a, 29b) are made in metal such as steel plate, in glass fiber reinforced plastic materials alone or glass fiber reinforced plastic materials reinforced with carbon fiber or aramid.

20 16. Handling system according to any of claims 12 to 15, where said system comprises two handling means (9, 9a, 9b, 29, 29a, 29b, 30) positioned on opposite side of the wind turbine blade.

25 17. Handling system according to claim 16, where said two handling means (9, 9a, 9b, 29, 29a, 29b, 30) directly or indirectly are connected by the mounting means (11-14, 26a, 26b, 28).

18. Handling system according to claim 16 or 17, where two flanges (27) are fastened to opposite ends of the handling means (29, 29a, 29b, 30) and establish the connection points for the mounting means (26a, 26b, 28).

19. Handling system according to any of claims 12 to 18, where said mounting means (11-14, 26a, 26b, 28) is one or more bolts (11, 13) or thread bars (26a, 26b) with corresponding nuts (12, 14, 28).
- 5 20. Handling system according to any of claims 12 to 19, where said mounting means goes through the wind turbine blade next to the beam (16) or any other strengthening structure in the blade e.g. close to the end of the beam at the tip of the wind turbine blade.
- 10 21. Handling system according to claim 20, where two of said mounting means (11, 13, 26a, 26b) go through the blade on opposite side of said beam (16) or any other strengthening structure in the blade.
- 15 22. Handling system according to any of claims 12 to 21, where one or more of the surfaces of said handling means comprise a high friction material (18) such as rubber.
- 20 23. Handling system according to any of claims 12 to 22, where said blade comprises at least one hole area with one or more reinforcement layers (19) on the inner surface of the blade (5).
- 25 24. Handling system according to claim 23, where said reinforcement layers (19) comprise glass fiber reinforced plastic materials alone or reinforced with carbon fiber or aramid.
- 25 25. Handling system according to any of claims 12 to 24, where the length of said blade is at least 30 meters such as approximately 39, 44 or 49 meters or more.
- 30 26. Handling system according to any of claims 12 to 25, where the weight of said blade is at least 6000 kilogram such as 6000 to 7500 kilogram e.g. approximately 6400, 6800 or 7200 kilogram.

27. Wind turbine blade (5) to be handled at least during storage, transport or mounting, said blade comprising at least one hole area with one or more reinforcement layers (19) on the inner surface of the blade and at least one hole
5 (22) where said at least one hole (22) penetrates the surface of the blade at the hole area.

28. Wind turbine blade according to claim 27, where said reinforcement layers (19) comprise glass fiber reinforced plastic materials alone or reinforced with carbon
10 fiber or aramid.

29. Wind turbine blade according to claim 27 or 28, where the surface of said at least one hole area includes visual signs indicating the location of the at least one hole
e.g. visual lines or circles.

15 30. Wind turbine blade according to any of claims 27 to 29, where one or more of said at least one hole is part of the lightning protection system of the blade e.g. lightning receptor holes.

20 31. Wind turbine blade according to any of claims 27 to 30, where the length of said blade is at least 30 meters such as approximately 39, 44 or 49 meters or more.

32. Wind turbine blade according to any of claims 27 to 31, where the weight of said blade is at least 6000 kilogram such as 6000 to 7500 kilogram e.g. approximately
25 6400, 6800 or 7200 kilogram.

33. Handling means (9, 9a, 9b) for a wind turbine blade at least during storage, transport or mounting, said handling means comprising
30 at least one surface substantially corresponding in shape to the section of the wind turbine blade that the handling means covers (5), and

one or more mounting holes for fastening means (11-14) fastening said handling means to the surface of the wind turbine blade by using at least one hole in the wind turbine blade.

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34. Handling means according to claim 33, where said means are made in metal such as steel plate, in glass fiber reinforced plastic materials alone or glass fiber reinforced plastic materials reinforced with carbon fiber or aramid.

10 35. Handling means according to claim 33 or 34, where one or more of the surfaces of the handling means comprise a high friction material (18) such as rubber.

36. Use of a handling system according to any of claims 12 to 26 and/or handling means according to claim 33 to 35 in connection with transport of one or more
15 wind turbine blades, such as one or more wind turbine blades according to any of claims 27 to 32, in transport containers or similar equipment for transport of wind turbine blades such as trolley vehicles.

37. Use for a method of handling a wind turbine blade according to claims 1 to 8 in
20 connection with transport from the place of manufacturing to the site of the wind turbine and/or subsequent transport away from the site of the wind turbine.